



The Ground Control Room as an Enabling Technology in the Unmanned Aerial System

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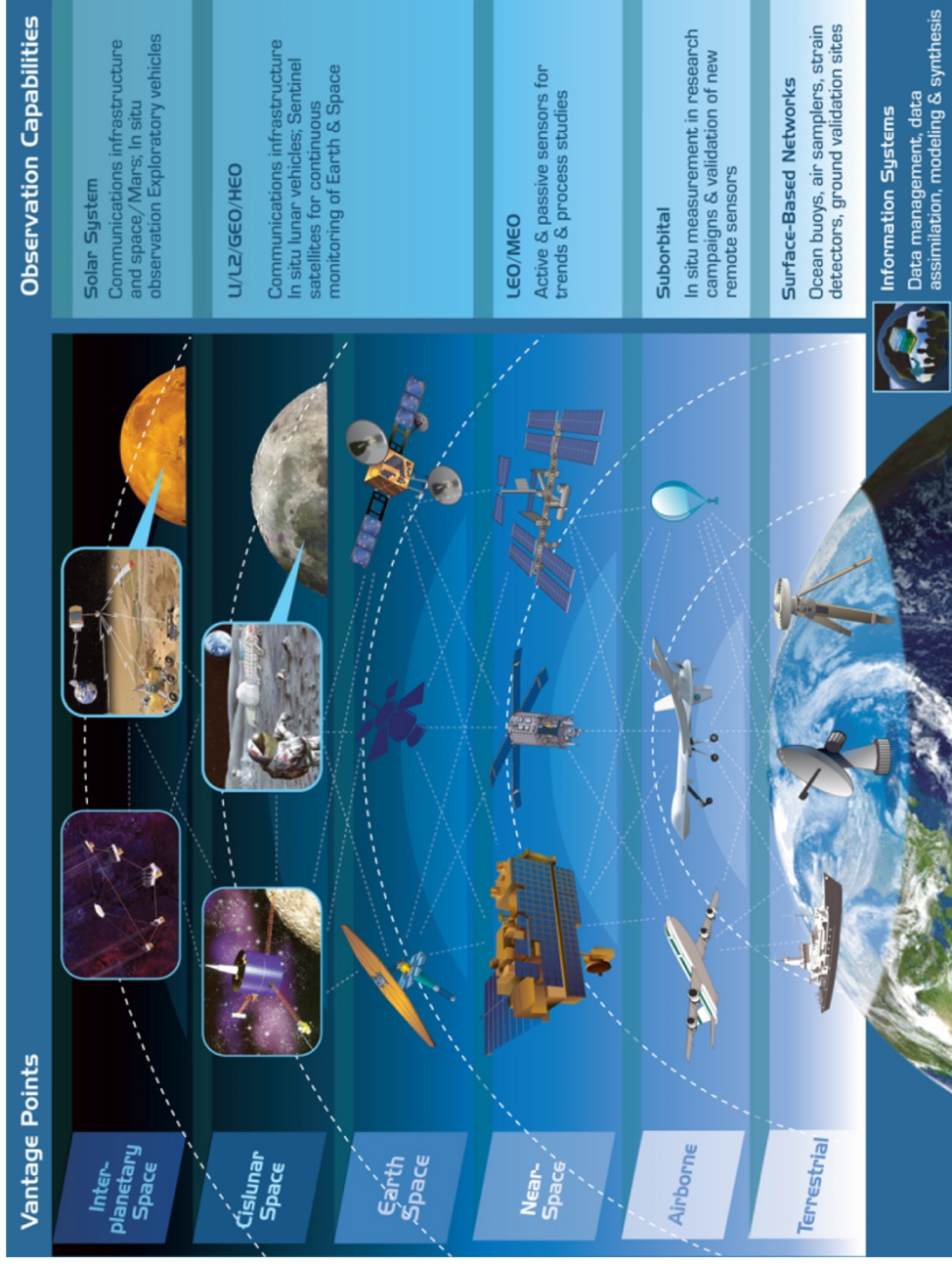


Helios

A photograph of the Helios solar-powered aircraft in flight. The aircraft is a high-wing, fixed-wing plane with a very long, thin fuselage and a large, rectangular solar panel array mounted on the upper surface of the wings. The aircraft is flying over a vast, snow-covered mountain range under a clear blue sky. The word "Helios" is written in a large, white, serif font across the upper portion of the image.

Global Science Needs

- UAS Strategic component of Global Observing System



Shared Airspace

Autonomous and Manned Vehicles

- **Contrast to Military Needs**
 - No Enemy
 - Non-cooperating A/C
 - Numerous Agencies involved
 - FAA NAS – COA process
 - ICAO International
- **Strong Emphasis on ELOS**
 - Sense and Avoid (SaA) non-cooperating A/C high priority
- **Social Responsibility**
 - Predictable decisions mitigating mission compromise situations





Unique Telemetry Needs

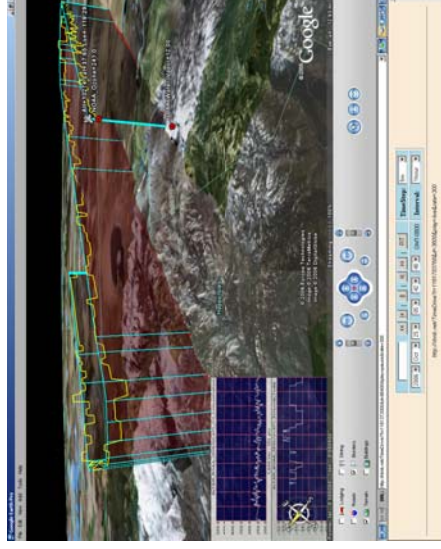
- **C2 must expand to support SaA sensor suites**
 - Near Term very heavy reliance on visual clues
 - Eventually image recognition technology can be incorporated in the A/C
- **Science data very different from C2**
 - Sensor WEBs
 - Disruption Tolerant
 - Bursty and Asymmetrical
 - Security requirements different

System of Systems

Flight Center



Science Center



Simulation Center



Pilot in a Bubble



NASA Dryden Flight Research Center Photo Collection

<http://www.dfrc.nasa.gov/Gallery/Photo/index.html>

NASA Photo: ED04-0056-85 Date: March 10, 2004 Photo By: Jim Ross

Pilot Bill Brockett (left) and Chilean Air Force Captain Saez with school children in the cockpit of NASA Dryden's DC-8 flying laboratory.

What Is

What Should Be



More than a pretty picture

- Use panoramic cameras to show features a pilot would see but unknown to the DTD
 - Cameras can be spectrally tuned for better clarity than available to a pilot
 - Camera resolution can be modulated
 - Enhances pilot ability to sense non-cooperating aircraft

Satellite Data Fusion

- Add satellite data to the camera images
 - Terrain
 - Land Cover
 - Infrastructure
 - Debris Field
- Simulation Center Fuses the GIS data to improve pilot's perception
 - Active contributor to the actual mission
- Provides the ability to simulate UAS flight
 - Training
 - Mission compromise simulation



Live Databases

- **Graphic Representation**
 - Data from ADS-B and Center RADAR (cooperative A/C)
 - On Board RADAR (non-cooperative A/C)
- **Provides the ability to represent non-cooperating aircraft in simulation**
 - Pilot training for SaA

Two [computer] Brains are better than One

- **Air [Flight Executive]**
 - Above Autopilot in Authority
 - Advises PIC in the event of a compromise situation
 - Able to make socially responsible decisions in the event of lost C2
- **Ground [Simulation Center]**
 - Provides Enhanced Situational Awareness
 - Fuses live camera images with
 - GIS data
 - Live data feeds
 - Provides Image Redundancy
 - Provides Simulation Capability
 - Training
 - V and V



Today, Tomorrow, and Beyond

- **Today**
 - heavy reliance on visual clues
 - Flight Executive Computer managing Flight Termination
- **Tomorrow**
 - Visuals enhanced with image recognition
 - On board RADAR
 - Flight Executive involved in compromise mitigation
- **Beyond**
 - Collision Avoidance built into the A/C flight Control System
 - Flight Executive handles mission compromises
 - Least Risk algorithms



A Beginning

